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Surveillance using Video Analytics

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***Abstract*—Surveillance using the video is a bit sophisticated task, yet making use of technology things can be done perfect. Security has been so difficult in the past that it was overlooked or avoided by security installers unless absolutely necessary. The present focus of computer vision Technology aimed at automating the analysis of Closed Circuit Tele Vision (CCTV) footages. This includes automatic identification of objects in a raw video, following those objects over time and between cameras, and the interpretation of those object's appearance and movements. Here achieving video analytics by implementing its segments, through Open CV with an e.g., Extracting the edges of a live video through web cam and finding the motion detection in Live video. In this paper we even discuss about the feature of 3-D sensors in video surveillance.**

***Key Terms*— Surveillance, video analytics, contours, RGB image, binary image, threshold**

I. INTRODUCTION

Video analytics is the effective use of computers for automatically identifying the things of interest without the requirement of an operator having to view the video. The most commonly used types of video analytics professionally deployed are perimeter violation, license plate recognition and people counting, object detection face detection. The commercial use of video analytics commenced in the year 2003. However, in the last few years, enthusiasm for video analytics has waned as numerous projects around the world. At the same time, only modest technological progress has been made in video analytics in the last 3 years.

Video analytics is the computerized moldings like transformation or modification and analysis of video recording footages that are captured by surveillance systems and analysis of pre-recorded video for the purpose of extracting minute detailed events, which is called as forensic analysis. Automatically monitoring the cameras and generate alerts for any unwanted events.

Video surveillance systems are typically installed to record video footage of areas of interest within a facility, around its perimeter or in outdoor areas which require observation, with a view to "catching" (allowing the user to be able to observe) and recording events related to security, safety, loss prevention, operational efficiency and even business intelligence.

Video Analytics enhances video surveillance systems by performing the tasks of real-time event detection as well as post-event analysis, while saving manpower costs and increasing the effectiveness of the surveillance system operation.

A.Video Analytics for Real-Time Alerts:

Through the implementation of various image processing algorithms, Video Analytics can detect a variety

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of events, in real-time, such as: penetration of unauthorized people/vehicles into restricted areas, tailgating of people through secure checkpoints, traffic obstacles, unattended objects, vehicles stopped in no-parking zones, highways or roads, removal of assets.
By defining the set of events that the surveillance system operator wants to be alerted to, the Video Analytics software continuously analyses the video in real-time and provides an immediate alert upon detection of a relevant event.

B.Video Analytics for Investigation:

In addition, Video Analytics algorithms may be implemented to analyze recorded video, a task that is challenging and time consuming for a human operator, especially in cases whereby a large amount of video must be reviewed. Through rapid analysis of recorded video, Video Analytics can perform the following tasks:

- Pinpoint an event in recorded video and retrieve the relevant video segment from the stored video
- Perform analysis of motion patterns and detection of motion irregularities in defined areas
- Perform a variety of statistical analysis tasks relating to people or vehicles over defined periods of time

II. State Of Art

Lee and Smeaton[1] describe a user interface to retrieve simple surveillance events like presence of person and objects. Real time palm tracking and Hand Gesture Estimation based on fore-arm contour [2] proposed an image processing system using a web camera. Differently from other hand recognition method, we are not trying to transfer the gesture to some certain instructions. We mark up the important features of hand: fingertips, palm center by computation geometry calculation, provide real-time interaction between gesture and the system. H.Arun et.al.[3]explores video parsing techniques which automatically extract index data from video, indexing which stores data in relational tables, retrieval which uses SQL queries to retrieve events of interest and the software architecture that integrates these technologies. Meesen et.al.[4] analyzed the instantaneous object properties in surveillance video key frames, and performed content-based retrieval using a generic dissimilarity measure which incorporated both global and local dissimilarities between the query and target video-key frames. Stringa and Regazzoni[5] proposed a content-based retrieval system for abandoned objects detected by subway station surveillance systems. We took this as keyword for our research and developed this paper. Situation Awareness, Early warning, Controlling access, Recording activity, Responsiveness are some of the main goals of the security provider. The hyper growth of the technology made our day to day life in light weight. Till date we rely on humans in providing the security, the day has come where computers are becoming more prompt than ordinary humans. So we thought of implementing the same in providing the security using the computer algorithms collaborated with Open CV.

III. Implementation of Video Analytics Through Open CV

Image is converted into binary image (having two bits 0's and 1's). This image is taken as input to analyze the quality of edges from the edge detection algorithms. For fast and efficient processing of the images for localization, only most important information has to be processed, identifying and locating sharp discontinuities, and the rest has to be left out. It is one of the basic and very important image processing tasks.
In general, edge detection methods may be grouped into two categories: Gradient (Sobel, Prewitt), Laplacian (Marr-Hildreth, Canny).
The **Gradient** method detects the edges by looking for the maximum and minimum in the first derivative of the image. represented in matrix format. Edges in an image can be detected using a periodical convolution of the function with specific types of matrices. For Sobel and Prewitt methods there are separate and standard convolution matrices.
The **Laplacian** method searches for zero crossings in the second derivative of the image to find edges.

- Step1: smoothing to reduce errors
- Step2: find second derivative by applying two dimensional laplacian.
- Step3: Look for sign changes in each and every pixel in laplacian of smoothed image.

A. Detection of Edges Using Canny

Algorithm used is Canny Edge Detection developed by John F. Canny in 1986. The criteria followed in 3 steps:

- Low error rate, No responses to non- edges
- Edge points be well localized
- To have only one response to a single edge [6]

B. Canny Edge Detection Algorithm Stages:

a. Noise Reduction: Canny edge detection is susceptible to noise present in unprocessed image data. So it uses a Gaussian filter for convolution which is an operation on two functions *f* and *g*, producing a third function that is typically viewed as a modified version of one of the original functions, giving the area overlap between the two functions as a function of the amountthat one of the original functions is translated. And the result is a blurred version of the original. The diagrammatic representation of convolution process is shown in Figure 1.

b. Finding Gradient of an Image: It is to find the direction of an edge. It uses four filters to detect the directions i.e. horizontal, vertical and the two diagonals in blurred image.

$$G = \sqrt{G_a^2 + G_b^2}$$

Where $G_x$is horizontal and G_y is vertical direction.

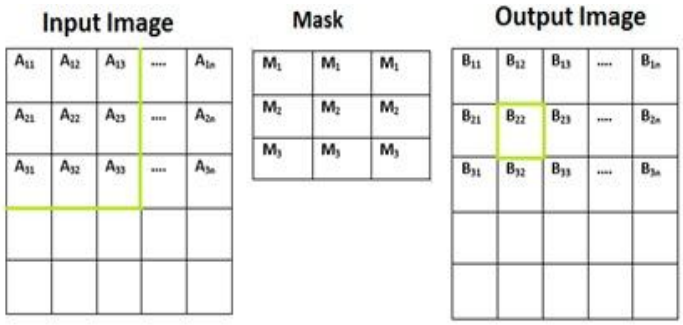

Fig 1.:Convolution process

$B_{22} = (a_{11}*m_{11}) + (a_{12}*m_{12}) + (a_{13}*m_{13}) + (a_{21}*m_{21}) + (a_{21}*m_{21}) + (a_{22}* m_{22}) + (a_{23}*m_{23}) + (a_{31}*m_{31}) + (a_{32}*m_{32}) + (a_{33}*m_{33})$

c. Non-Maxima Suppression:

The edge magnitude may contain wide ranges around local maxima, which are seen as thick edges, preserving the connectivity of contours.

d. Threshold with Hysteresis:

There are two types of thresholds namely high threshold and low threshold. Where the high threshold mark out the edges fairly sure or exact and the low threshold is used to trace the faint edges as long as we find a starting point.

C. Requirements to perform edge detection:

1. A computer system with a web camera connected to it / inbuilt
2. Install Microsoft visual studio 2008 or upgraded which is an Integrated Development Environment (IDE) from Microsoft and is used to develop console and graphical user interface applications
3. Install OpenCv (Open Source Computer Vision Library) which is a library of programming functions mainly aimed at real-time computer vision, developed by Intel Corporation Ltd.
4. The libraries, include files and sources have to be added to the Visual C++ directories
5. Create a win32 console application and add the project properties into it.

The another method in this line to find the accurate edges is **Cellular Neural Networks (CNN)**. The CNN model is a class of Differential Equation that has been known to have many application areas and high operational speed and uses the synaptic weight & templates to detect the discontinuity.

D. Description of process:

The terms used in the paper are referred in [7]. Define the required terms to be used in the program. Instantiate the threshold values (high, low).The command cvCapture is used to capture the video from the webcam .In pre-processing we use cvCvtColor to convert the RGB image into grey scale.

We use cvQueryFrameto divide the video into frames and put them in query. Now we apply cvcannyto the each frame and find the edges. Now we usecvWaitKey to control the frame flow, finally we use

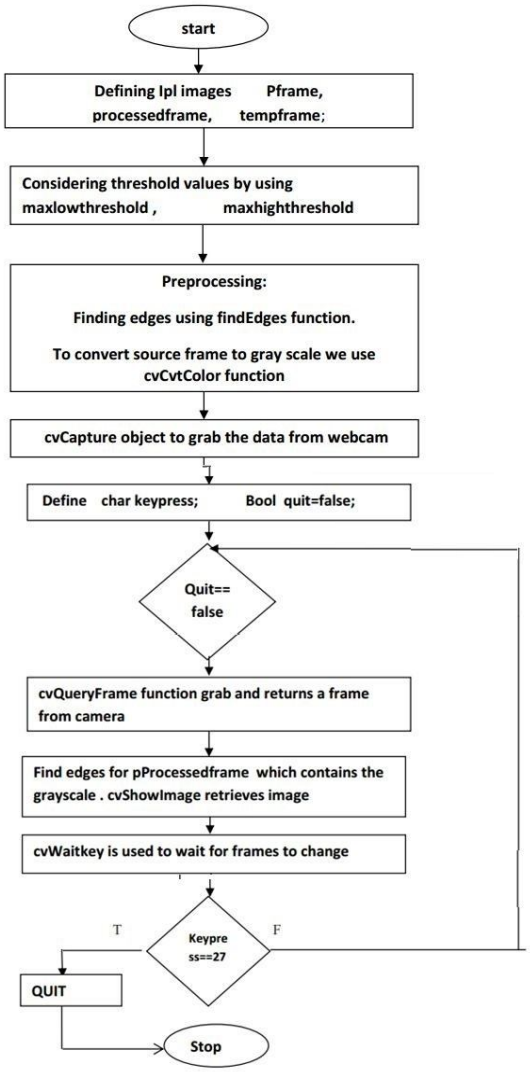

Fig 2.Flow-chart of the live example

cvShowImageto show the required output. Edge detection is helpful in the applications like Enhancement of noisy images – satellite images, x-rays, medical images like cat scans, Text detection, Mapping of roads , Video surveillance, replace image by a cartoon in which objects and surface markings are outlined these are the most informative parts of the image, extracting details like size, shape, etc., of an image. Edge detection is massively important as it is in many cases the first step to object recognition. Thepseudo code of the motion detection is as follows: Initially we create a new movie capture object and storage for contours. We capture current frame from webcam. Convert the images that are from video to grayscale.Capturing Background for the first time and minus the current frame from the moving average.Blur the difference image. Apply threshold to discard small unwanted movements. Find contours of image and draw bounding box around each contour. Extract bounding box for current contour. Drawing rectangle around bounding box. Display color image with bounding box along with threshold image.

IV. TEST RESULTS/ OUTPUTS

Fig 3.Live edge detection

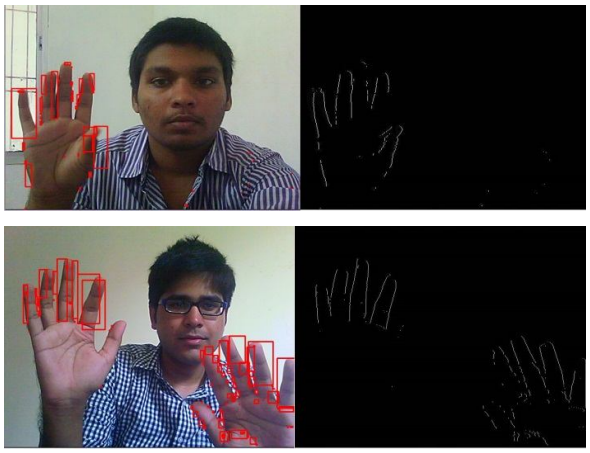

Fig 4.Live Motion Detection

In figure 3, Edge detection is done with the live video which is being captured from web-cam. Good results are produced only when we have abundant light since we are capturing with the help of web-cam. The flow chart for this example is shown in Figure2. In figure 4, Motion detection is being carried out of live video from web-cam. The objects which are in motion are identified and surrounded with red boxes and only the objects which are in motion are detected and displayed.

V. BENEFITS AND LIMITATIONS OF VIDEO ANALYTICS

A. Real-Time Effective management of the monitoring system:

Video analytics allows us to better monitor our location with the smartest and latest security technology. It allows less time to be used up monitoring multiple video feeds and quicker response times. Any of the alerts can be notified using a voice call or SMS or any other means of communication[8].

B. Quality of Surveillance:

The quality of surveillance depends upon the video quality and effective way of using algorithm. Good results are observed when the surveillance is done offline rather online or real-time. In Figure 5(b). No Parking violation can be detected.

C. Accuracy

Video analytics maintain a wide range of accuracy. Accuracy even depends upon the ambience environment and light. In the presence of good light the results are more accurate compared to the low- light conditions. The low-light makes the image more noisy, which when being trying to cancel detail of the image will be lost.

D. License Plate Recognition

Deployment of the proposed system is placed at the required location gives us a facility where it catalogues the licence plate of each of the arriving and departing vehicles. After the recognition and extraction of the unique number from the registration plate, the same information is used to extract the information of the vehicle and the owner at same time. When the restricted vehicle is entering into the ambience, the control could be done at instance. Just as shown in Figure 5(a).

E. Missing/Strange Object Recognition

Video analytics within a CCTV system also allow you to monitor for missing or unwanted objects. Video analytics can detect when an object has been left behind when the video from a CCTV camera displays an object not part of the normal video scene.[8] This causes it to trigger an alarm within your CCTV system. Video analytics can also do the reverse to watch for any missing objects. When a camera within your CCTV system has a change in the video scene that shows that an object is missing, the video analytics software is smart enough to trigger an alarm. Just as shown in Figure 5(c).

F. Secured Access Points

Integration of video analytics into a CCTV system with security access points offers several benefits. Using the Video analytics we can determine the behaviour of people outside of an access point. The mood of the people in an area and their behaviour can be tracked. This can include loitering, studying of the security cameras or eventailgating. When using video analytics in your access point CCTV system, you allow the cameras to better monitor traffic around security access points. Alarms can be set that will trigger when people within the CCTV cameras view are acting strangely or entering an area they are not permitted.

G. Auto-Tracking

Cameras having the capability of pan, zoom, tilt features within them are much useful for surveillance purpose. This allows for the auto-tracking capability. The video analytics software will be able to move the PTZ camera to follow the motion within the video view. Some video analytics software can also zoom in on the target to provide a better view of the intruder. This kind of Auto-Tracking is much useful in finding the small objects which are lost.

H. Ease of Implementation

Implementation of the advanced surveillance kit is as simple as installing external web-cam for Desktop. We just need to integrate the CCTV or any other camera to the software.

I. Reduced Labour Costs

With the ordinary CCTV surveillance camera someone have to be monitored for any unwanted action, the same here is done by the advanced system 24x7 and in case of occurring any un-wanted action or event, the alert message hits us. This makes us economically feasible in terms of labour cost.

(a) (b)

(c)

Fig 5.(a) Number plate recognition (b) No parking violation, (c) Missing object recognition

Using 3D sensors like Microsoft Kinect and Prime Sense with proprietary algorithms detects people, when they are in sensor reach. With the products line Microsoft Kinect for Windows, they can calculate the depth and distance of the object from the sensor and give us appropriate information. These types of sensors provide us more information compared to the ordinary RBG cameras. The analysis can be done in such a way that the whole activity of the object can be recorded and analyzed [9][10]. For example let us assume the whole setup is set in the super market and the depth sensors are recording the information. We can analyze how many customers are looking for a particular product and after looking upon it are they purchasing the same or leaving it behind. We can also detect the number of customers present on the floor.

VI. CONCLUSIONS AND FEATURE WORK

The revolution has just begun. Video content analysis has started making an impact. Digital media becomes far powerful, once it is paired with automated recognition. Outdoor security is finally practical and reliable. Cameras become intelligent detectors when combined to video analytics. Using 3D sensors like Microsoft Kinect and Prime Sense with proprietary algorithms detects people, when they are in sensor reach. With the products line Microsoft Kinect for Windows, they can calculate the depth and distance of the object from the sensor and give us appropriate information. These types of sensors provide us more information compared to the ordinary RBG cameras. The analysis can be done in such a way that the whole activity of the object can be recorded and analyzed. For example let us assume the whole setup is set in the super market and the depth sensors are recording the information. We can analyze how many customers are looking for a particular product and after looking upon it are they purchasing the same or leaving it behind. We can also detect the number of customers present on the floor. The power of guards is multiplied with video analytics. Live video combined with recognition offers instant response and situational awareness from anywhere in the world, through sensors that never blink or sleep. Travelling from early stages of video analytics to advanced technologies, sophisticated behaviour recognition becomes easier. Today there are many practical applications that provide better protection with significant cost savings. This is just beginning of a change that will transform the whole world of security.

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